

Remarks

Claims 1-13 remain in the application and are patentable over the art of record.

In the Office Action, claims 1-11 were rejected under 35 U.S.C. §103(a) on the basis of Bryant et al. U.S. Patent 6,264,765 taken in view of Yasuhara et al. (U.S. Patent 6,290,784), as follows:

Bryant et al. disclose the method for producing an aluminum alloy, AA5754 alloy (table 2), comprising the steps of providing a source of molten aluminum providing a caster, rolling the caster into a sheet product, continuously annealing the sheet product at a temperature in a controlled temperature range, measuring the degree of annealing of the sheet product (col. 5, lines 55-60), relaying the signal to the controller (23), wherein the controller, comparing the signal to previous signals relating to degree of annealing of the sheet product to provide a comparison, and in response to the comparison, maintaining or changing the temperature upward or downward to produce desired annealing (col. 5, lines 40-67). The hot mill entry temperature is in the range of 700 to 1100 degrees C (col. 6, line 23). The twin belt casting is to produce a slab of 0.2 to 2 inches thick (col. 4, line 41). Hot rolling of the slab to a thickness in the range of 0.01 to 0.25 inch (col. 4, line 46).

Applicants have contrasted their invention with conventional technology in their application at page 12, ¶0037 as follows:

[0001] This process is to be contrasted with conventional technology wherein casting, hot rolling, and annealing take place to produce a roll or coil of sheet product and *samples are then cut from the roll to determine if the sheet product contained in the roll has acceptable texture and grain structure for forming*. If the roll of sheet product does not have acceptable texture or grain structure, then it has to be *reprocessed or scrapped*. (Emphasis added.)

The Bryant et al. reference is considered by Applicant as part of the conventional technology because if it does not have acceptable texture or grain structure, it has to be scrapped. It should be noted that Bryant et al. is *silent* with respect to controlling grain structure or recrystallization. That is, in Applicants' invention, as noted at page 11, ¶0035, third line from the bottom:

... the process is controlled to change operating conditions on-line in real time, such as hot rolling temperature and annealing temperature, for example, to obtain sheet product having the fully recrystallized fine grain structure sometimes referred to as primary recrystallization. Care is required to avoid over annealing and the growth of fine grains to provide large grains or abnormal grain growth referred to as secondary recrystallization which lead to low formability and high earing.

It will be appreciated that the present invention has the capability to consistently and continuously produce aluminum alloy sheet product having highly desirable texture and grain structure, e.g., completely recrystallized, for improved forming with low or optimum earing.

Applicants' invention is concerned with measuring the degree of recrystallization or grain structure and uses this measurement to control the process, as follows:

[0049] In accordance with the invention, the texture and/or grain structure of hot rolled or annealed sheet product is measured on a continuous basis using texture and grain structure analyzer 60 and a texture and grain structure related signal is directed along line 62 to controller 100. In response thereto, operating conditions such as hot rolling temperature, hot rolling reduction and/or speed, mill coolant, or anneal temperature, can be adjusted, if necessary, to provide a sheet product having the desired texture and grain structure. Thereafter, sheet product 42 may be cut by shear 44 and coiled into coils 48 and 49. Thus, it will be seen that using the on-line texture and grain structure analyzer optimum conditions can be maintained to produce a sheet product having texture and grain structure which provides, for example, high formability and low or optimum earing resulting in minimal scrap generation or reprocessing of coils having unsuitable forming characteristics.

[0050] That is, the on-line texture and grain structure analyzer 60 measures the quality of sheet product, for example, from the hot rolling or annealing operations, depending on the process, and generates a texture and grain structure signal or measurement. This signal or measurement is relayed to controller 100 along line 62. Controller 100 is set up to compare the present texture and grain structure measurements with prior texture and grain structure measurements or a standard or range of texture and grain structure measurements. Controller 100 then determines, for example, if the temperature of sheet in annealer 40 should be maintained or adjusted upwardly or downwardly within a controlled temperature range to maintain or improve the texture and grain structure and thus maintain

or improve formability of the sheet product being produced. Likewise, hot rolling temperature may be maintained or adjusted upwardly or downwardly individually within a controlled temperature range or in conjunction with anneal temperature to maintain or improve the texture and/or grain structure suited to the desired levels of formability and/or earing.

Thus, it will be seen that Applicants' invention is concerned with a completely different invention from that described in Bryant et al. Bryant et al. describes and claims the use of *inductive* heating and states this fact in col. 1, lines 7 to 13, as follows:

The present invention is directed to an improved method and apparatus for casting, hot rolling and annealing non-heat treatable aluminum alloys, and, in particular to a method of *inductively heating* a cast and hot rolled aluminum alloy sheet directly after hot rolling to continuously produce an annealed aluminum alloy product, thereby eliminating the need for multiple processing lines. (Emphasis added.)

Bryant et al. also states at col. 2, lines 50 to 54, as follows:

According to the invention, the hot rolled product is directly inductively heated from an elevated temperature caused by the latent heat in the hot rolled product to a final annealing temperature to form a final annealed product.

Further, Bryant et al. notes that the inductive heating is controlled on a heating parameter at col. 2, lines 54 to 58, as follows:

The inductive heating is controlled using a feedback control based on at least one heating parameter, e.g., the temperature of the hot rolled product entering the induction heating zone. The surface of the final annealed product can be protected prior to coiling.

However, it should be noted that in the process of Bryant et al., coupons must be cut from coils of sheet and analyzed for texture and grain structure, as referred to earlier. That is, Bryant et al. is *silent and does not disclose* Applicants' invention. Bryant et al. is *silent* with respect to *on-line* determination of texture and grain structure during production and immediate or on-line controlling or changing of texture and grain

structure to continuously produce sheet having the desired forming and earring characteristics.

Applicants' invention is set forth in claim 1 which is provided as follows for convenience:

1. A process for producing an aluminum alloy sheet product having a controlled recrystallization using a continuous caster to cast a molten aluminum alloy into a slab comprising:
 - (a) providing a source of molten aluminum alloy;
 - (b) providing a caster for continuously casting said molten aluminum alloy into a slab;
 - (c) rolling said slab into a sheet product;
 - (d) continuously annealing said sheet product at a temperature in a controlled temperature range;
 - (e) *measuring degree of recrystallization of said sheet product on a continuous basis to provide a recrystallization related signal;*
 - (f) relaying said signal to a controller;
 - (g) in said controller, comparing said signal to previous signals relating degree of recrystallization of said sheet product to provide a comparison; and
 - (h) in response to said comparison, maintaining or changing said temperature in said temperature range upwardly or downwardly to produce aluminum sheet product having desired recrystallization. (Emphasis added.)

It will be seen that Bryant et al. is *silent* with respect to step (e) which requires "measuring the degree of recrystallization of the sheet product on a continuous basis to provide a recrystallization related signal".

The United States Patent and Trademark Office agrees that Bryant et al. are *silent* with respect to step (e).

Thus, for a first reason, Applicants' invention is patentable over Bryant et al., taken singly or combined with Yasuhara et al.

It is submitted that Applicants' claim 1 is patentable over Bryant et al. for a second reason. That is, claim 1(f) requires taking the recrystallization related signal and "relaying said signal to a controller". Clearly, Bryant et al. is *silent* with respect to relaying a *recrystallization related signal* to a controller.

It is submitted that Applicants' invention is patentable over Bryant et al. for yet another reason. In claim 1, step (g), the recrystallization related signal is compared to previous signals relating to the degree of recrystallization to provide a comparison. Again, Bryant et al. is *silent* with respect to such step.

Further, it is submitted that Applicants' invention is patentable over Bryant et al. for a fourth reason. In Applicants' invention, claim 1, step (h), it is required that in response to said comparison in step 1(g), the annealing temperature is either maintained or changed upwardly or downwardly to produce sheet having the desired recrystallization. It will be seen that Bryant et al. is *silent* to this step or series of steps in which the degree of recrystallization is measured and used to control the process. This has the advantage of avoiding coils of scrap because recrystallization can be changed as the sheet product is being produced.

Because Bryant et al. is *silent* with respect to these steps, it is submitted that Bryant et al. cannot make Applicants' invention, as claimed, obvious.

Claims 2-13 are patentable over Bryant et al. and Yasuhara et al. for the reasons provided above.

It is respectfully submitted that Bryant et al. does not disclose measuring the degree of recrystallization aluminum alloy sheet, relaying the recrystallization related signal to a controller, comparing recrystallization related signals to previous signals in a controller or maintaining or changing temperature based on the comparison to produce the desired recrystallization.

Even if Bryant is taken in view of Yasuhara, the combination does not make Applicant's invention obvious, as set forth in the claims. With respect to Yasuhara, the Patent Office notes as follows:

Yasuhara et al disclose measuring the degree of recrystallization for the purpose of monitoring the working temperature (col. 9, lines 37-43, col. 10, lines 23-31).

It should be noted that Yasuhara is concerned with hot rolled *steel* sheet and is *silent* with respect to aluminum sheet. Thus, it is respectfully submitted that

Yasuhara is considered non-analogous art and is not pertinent to the subject invention. That is, one skilled in the steel art would not be skilled in the aluminum art. Accordingly, it is respectfully submitted that Yasuhara should be withdrawn as a reference because it does not disclose anything about rolling aluminum sheet.

In the Office Action, Applicants' attention is directed to Yasuhara at column 9, lines 36-42, which read as follows:

The dynamic recrystallization temperature range is measured in advance from the relationship between strain and stress by simulation of rolling conditions. The simulation and measurement of steel is carried out using a measuring machine in which temperature and strain are individually controlled (for example, "Forming Formaster" manufactured by Fuji Denpa Koki Co.).

It is noted that the recrystallization temperature range is measured in advance . . . It must be emphasized that this statement is made with respect to steel sheet, and Applicants have no way of determining how such would be applied to aluminum alloy sheet.

Assuming it could be applied to aluminum sheet, it should be noted that the recrystallization *temperature* range is measured in advance . . . It is respectfully submitted that Applicants are measuring the degree of *recrystallization* (see claim 1, step (e)). Applicants are not measuring recrystallization *temperature* or temperature range. Thus, it will be seen that these are different concepts. Accordingly, Yasuhara cannot make Applicants' invention obvious, taken singly or combined with Bryant.

It should be noted that the recrystallization temperature range of Yasuhara is measured in advance . . . by simulation of rolling conditions. As noted earlier, in Applicants' invention, measurements are *on-line in real time* (see page 11, ¶0035).

. . . the process is controlled to change operating conditions on-line in real time, such as hot rolling temperature and annealing temperature, for example, to obtain sheet product having the fully recrystallized fine grain structure sometimes referred to as primary recrystallization. Care is required to avoid over annealing and the growth of fine grains to provide

large grains or abnormal grain growth referred to as secondary recrystallization which lead to low formability and high earing.

Applicants recrystallization measurements are made on-line and not on a simulation of rolling conditions. Clearly, these are two different inventions, and Yasuhara is *silent* with respect to measuring the degree of recrystallization of aluminum alloy sheet product (see claim 1(e)). Thus, Applicants' invention is patentable over Yasuhara, taken singly or in combination with Bryant.

In the Office Action, the Patent Office refers to column 10, lines 23-31 of the Yasuhara patent, which is as follows:

To ensure the number of cycles of rolling in the low-temperature region of the dynamic recrystallization temperature and to prevent the temperature of the steel material from declining during rolling, a heater is preferably disposed between rolling stands. The phrase "between rolling stands" means "between rolling stands or between rolling apparatuses" in a rolling mill. The heater is preferably arranged at a position susceptible to an extreme decline in temperature. FIGS. 1A and 1B illustrate examples of the heater.

It is noted that this statement refers to placing heaters between the rolling stands to maintain the temperature of the steel material from declining during rolling and is not concerned with measuring the degree of recrystallization as set forth in Applicants' claim 1(e).

Thus, it is respectfully submitted that Applicants' invention as set forth in the claims is patentable over the combination of Bryant and Yasuhara.

In the Office Action, claims 12 and 13 were rejected under 35 U.S.C. 103(a) on the basis of Bryant et al. taken in view of Kamat as follows:

Claims 12 and 13 rejected under 35 U.S.C. 103(a) as being unpatentable over Bryant et al. (US '756) as applied to claim 1 above in paragraph 3, and further in view of Kamat (US 5,634,991).

Bryant et al disclose the claimed invention above, but fail to teach cold rolling the hot strip after annealing step to a gauge in the range of 0.01 to 0.16 inch.

However, Kamat discloses the method of cold roll after annealing and having a final gauge of 0.02 inch for the purpose of improving formability.

Therefore, it would have been obvious to one of ordinary skill in the art at the time Applicants' invention was made to have cold rolled after annealing as taught by Kamat, in Bryant et al. in order to improve formability.

It is respectfully submitted that claims 12 and 13 are dependent on claim 2, which is dependent on claim 1. Thus, claims 12 and 13 have all the limitations of claim 1. As noted above, claim 1 is patentable over Bryant et al. It is respectfully submitted that claims 12 and 13 are patentable over Bryant et al. for the reasons set forth above with respect to claim 1. Further, it should be noted that Kamat does not supply the parts missing in Bryant et al. That is, Kamat is concerned with an alloy and method of making the same as follows:

A method for making aluminum alloy can stock from continuously cast aluminum alloy slabs includes the steps of continuous casting, hot rolling, hot line annealing, cold rolling, intermediate annealing and cold rolling to final gauge. After the material is cold rolled to final gauge, it is subjected to a heat treatment step which improves its formability. The method is suited for improved AA3000 series type alloys. Besides improved formability, the inventive method also provides increased alpha phase content and low earing percentage for improvements in can manufacture. An improved aluminum alloy product also is disclosed.

However, Kamat is *silent* with respect to Applicants' method of controlling the process using train structure or recrystallization. Thus, Kamat does not supply the parts missing in Bryant et al. Accordingly, it is respectfully submitted that claims 12 and 13 are patentable over this combination.

In view of the amendments and remarks, the subject application is now in condition for allowance, and such is requested at an early date.

Respectfully submitted,



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